Citation:

Dharod JM, Pérez-Escamilla R, Paciello S, Venkitanarayanan K, Bermúdez-Millán A, Damio G. Critical Control Points for Home Prepared 'Chicken and Salad' in Puerto Rican Households. *Food Protection Trends* 2007; 27: 544-552.

Study Design:

Cross-sectional study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

⬤ NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To apply the Hazard Analysis and Critical Control Point (HACCP) principles and identify sanitation and food handling critical control points for home prepared "chicken and salad" using objective measurements such as direct observations and microbiological indicators.

Inclusion Criteria:

- Puerto Rican female
- Main meal preparer of the household
- Living in Hartford, CT
- Did not participate in the pilot study
- Signed informed consent.

Exclusion Criteria:

- Not a Puerto Rican female
- Not a main meal preparer of the household
- Not living in Hartford, CT
- Had participated in the pilot study
- Did not sign informed consent.

Description of Study Protocol:

Recruitment

- A bilingual (English/Spanish) and bicultural community outreach worker trained by a Puerto Rican research staff member with expertise in food safety on how to recruit participants (and conduct the household observation)
- Puerto Rican women were recruited through local schools, grocery stores, the Supplemental Nutrition Program for Women, Infants and Children (WIC) offices, and neighborhoods of inner city Hartford, CT

- The dates for the household visits and observation were decided in full consultation with the study participants after the study consent form had been signed.

Design

- A pilot study was conducted in 10 households prior to collecting the data for the main study:
  - To test, streamline and standardize the microbiological testing and sample collection procedure
  - To develop a household observation checklist
  - For testing the protocols and procedure for the main study
- Ten stimulation studies were conducted during the pilot study to rule out secondary microbial contamination during the delivery of ingredients to the household and collection of samples from households to microbiology laboratory
- For each household, two visits were conducted in three days:
  - First visit (First day): Food ingredients (pack of chicken breasts (CB) with skin and bones, head of iceberg lettuce and tomatoes (LT), oil, salad dressing and common Puerto Rican spices (adobo, sazòn, sofrito) were purchased at local grocery store; stored at $\leq 4^O$C in ice coolers (except for spices kept at room temperature); sampled in a microbiology lab for baseline total and counts for pathogenic species; re-packed, and delivered to participants' homes. Upon delivery, refrigerator and freezer temperatures were measured by calibrated thermometers and participants were asked to freeze the CB (and then defrost it for dinner preparation two days later) and refrigerate the LT
  - Second visit (Third day): Participants were asked to follow own recipe but to use only ingredients delivered related to the study; kitchen items (counter, refrigerator/freezer handles, knife and cutting board surfaces) were sampled before meal preparation; the defrosted CB, knives and cutting surfaces and the LT were sampled during the preparation process and an extensive household observation was conducted and pre-coded checklist was used to record participant food safety practices. CB internal temperature was checked once participant declared it was cooked, with a sample taken only if temperature was $\leq 165^O$F or 75°C. All samples collected were transported in coolers maintained at $\leq 4^O$C
- Microbiological Testing: All the collected food and counter or cutting board samples were tested for total bacterial and coliform counts and for the presence of *Campylobacter*, *Salmonella*, *Listeria genus* and *S. aureus*. Refrigerator/freezer handles and knife samples were tested only for presence of pathogenic genus.

Dietary Intake/Dietary Assessment Methodology

Not applicable.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

- 12.0 version of SPSS used to enter and analyze microbiological and direct observation data
- Descriptive statistics and frequencies were used to assess percentage of samples testing positive for pathogenic species
- Analysis of Covariance (ANCOVA) was used to determine the changes in total and coliform counts by various food handling practices
- A cross-contamination model was developed based on significant Pearson Correlation coefficient between different stages of meal preparation
- The non-parametric MacNemar test was conducted to estimate the statistical significance of the difference in the presence of pathogenic species in food at the retail level and after participants' handling.

Data Collection Summary:

Timing of Measurements

First day of study:

- After purchase, food ingredients were taken to the microbiology laboratory and sampled to determined the presence of any pathogenic species and establish baseline total and coliform counts
- Then, later on same day, foods were delivered to participant households and refrigerator and freezer temperatures were measured by use of calibrated mercury thermometers

Third day of study (and second visit to participants' homes):

- Surface samples (refrigerator/freezer handles, kitchen counter, knife and cutting board) was collected before meal preparation and after they were used to cut or clean the chicken breast
- A defrosted chicken breast sample was collected after the participant had handled the chicken breast or just before the participant stated cooking the chicken breast
- A cooked chicken breast sample was taken for microbiological analyses only if the temperature measured was ≤165°F or 75°C
- A lettuce and tomato sample was obtained once the vegetables were washed (if done) and cut or once they were ready to serve
- A pre-coded checklist was used to record participant food safety practices during the participants' preparation of the 'chicken and salad' meal.

Dependent Variables

Total bacterial counts and coliform counts and presence of *Salmonella, Listeria, S. aureus, Campylobacter*, after participant handling:

- Sterilized tongs were used to collect the food samples (two samples of chicken breast/lettuce/tomatoes)

- Sterile templates and prepackaged sterile swabs dipped in Tryptic Soy Broth (TSB) plus 0.6% Yeast Extract (YE) were used to collect the surface samples (refrigerator/freezer handles, knife, kitchen counter, cutting board surface)
- Food samples (approximately 25g) were placed in 100ml TSB plus 0.6% YE and homogenized in a stomacher (Tekmar, OH) for one minute; for surface samples ($50cm^2$), swabs were placed in 50ml TSB plus 0.6% YE
- The samples were then serially diluted in 0.1% Peptone Buffer, spread plated and incubated (37°C) for 24 hours
- Remaining samples, placed in TSB plus 0.6% YE, were enriched by incubating at 37°C for 24 hours and streaked on the respective agar to identify the presence of *Salmonella* (Xylose Lactose Trichlorate Agar, Difco), *Listeria* (Oxford Agar, Difco) and *S. aureus* (Mannitol Salt agar, Difco); to detect *Campylobacter*, samples were placed in *Brucella* broth plus 0.5% sheep's blood, after which they were incubated at 42 °C under micraerophillic conditions for 48 hours in an anaerobic incubator, the sample was streaked on Karmali agar (Oxoid) to be incubated under similar conditions as before.
- If positive colonies were observed, these confirmatory tests were conducted:
    - *Salmonella:* Agglutination test, API-20 E test
    - *Listeria:* Gram staining, hemolysis test on blood agar, API *Listeria* test
    - *S. aureus:* Gram staining, hemolysis test on blood agar, Staphytec Plus test
    - *Campylobacter:* Microscopic motility test, Gram staining, API Campy.

Independent Variables

Observed participants' behavior:

- Thawing method
- Hand washing
- Use of cutting surface
- Washing of cutting surface
- Washing of knife
- Washing of LT.

Control Variables

- Total bacterial counts at the retail/baseline level
- Coliform counts at the retail/baseline level.

Description of Actual Data Sample:

- *Initial N:* 60 Puerto Rican women
- *Attrition (final N):* 60
- *Mean age*: 40 years
- *Ethnicity*: Puerto Rican women
- *Other relevant demographics*:
    - More than half (N=36) spoke only Spanish at home
    - Half of the participants (N=33) had less than a high school education
    - Half of the participants (N=33) had a monthly income of $1,000 or less
    - The majority (N=51) were unemployed
- *Anthropometrics*: Not applicable

- *Location*: Hartford, Connecticut, USA.

Summary of Results:

Key findings

- Comparisons between observation and microbiological results:
    - Total bacterial and coliform counts of CB were significantly higher if participant used counter as a cutting surface
    - Total bacterial count of CB was significantly higher when CB was thawed on the counter rather than with other thawing methods
    - Total bacterial and coliform counts of LT were significantly higher for unwashed LT (whole or after cutting) than for washed samples.
- Cross-contamination model
    - There was a significant positive correlation in coliform count between:
        - The cutting board sample collected before meal preparation and the CB sample taken after participant handling (thawing, cutting or washing (if done)) (r=0.361, P=0.019)
        - CB sample after participant handling and cutting board sample taken once it was used to cut the CB (r=0.453, P=0.009)
        - Cutting board sample after its use and LT sample collected after handling (cutting or washing (if done)) (r=0.416, P=0.020).
- This correlation strongly suggests that during meal preparation there was transfer of coliforms, especially from one food to another
- Microbiological results (tested pathogen genus in food and surface samples):
    - *S. aureus* was most commonly found pathogen in tested food and surface samples, and there was no significant decrease in the incidence of S. aureus in any food samples as a result of participants' handling
    - The incidence of CB *Listeria* decreased significantly at the household level in relation to the retail level (P<0.05), while it remained almost same on LT samples
    - On kitchen surfaces, 9% of cutting board and knife samples collected after CB had been cut, tested positive for Listeria
    - At household level, *Listeria monocytogenes* was found on 5% of CB, 2% of LT and 5% of cutting board or counter samples (all those that tested positive in home were also positive for L. monocytogenes at the retail level)
    - Cutting board of counter was positive for L. *monocytogenes* when a positive CB was either cut of kept for thawing on the particular surface
    - At household level, 5% of CB tested positive for *Campylobacter* and *Salmonella* genus with no LT sample yielding these bacteria at household or retail level.

Household Observation Behavioral results:

- Storage
    - 53% of measured refrigerator temperatures ranged from zero to 4°C
    - 42% from five to 10°C
    - 5% were from 11 to 14°C
    - 65% of the freezers having sub-optimal or higher than recommended temperatures (range was from -4 to -20°C).
- Thawing:
    - 43% of the participants thawed CB on the counter (for five hours on average)

- 28% thawed CB in refrigerator
- 15% thawed CB in water
- 14% thawed CB using a combination of methods (i.e., initially in refrigerator, then in cold or hot water or on counter)
- Among those who thawed CB in water, 46% kept it in stagnant water and did not change water for more than two hours
- Handling:
  - Before handling CB, 25% washed hands with soap and water
  - A cutting board was used by majority (72%) but kitchen counters were second most common surfaces used to cut CB (13%)
  - After handling CB and before handling LT, most (75%) of participants did not wash their hands or washed them with water only
  - 13% did not wash the LT
  - To cut the LT:
    - 67% used a cutting board
    - 7% used counter
    - 17% used a plate
  - Of those who used the same cutting board to cut CB and LT, only 55% washed the cutting board with soap and water in between use
  - 13% of households used the same knife for cutting CB and LT without washing it in between
- Cooking:
  - None of the participants used a thermometer to check whether the CB was adequately cooked
  - Most common methods of determining doneness of the CB were cooking time and visual checking of change in texture and color of the meat; while some participants (20%) tasted the meat to determine if it was done
  - Temperature measurements by research staff on meat showed that 93% of participants cooked the CB to an adequate temperature (≤165°F or 75°C).

Author Conclusion:

- These stages of meal preparation were identified as sanitation and food handling "Critical Control Points" (CCPs):
  - Chicken breast thawing
  - Cutting chicken breast
  - Hand washing after handling chicken breast and before handling lettuce/tomato
  - Washing of lettuce/tomato or fresh produce.
- In this study, which presumably is the first one examining CCPs in low-income US households, the food safety factors identified were associated not with lack of key amenities (e.g., refrigerators, cooking devices), but perhaps with lack of knowledge or negative attitudes toward food safety risks
- Populations of coliforms and tested pathogenic species increased more on the unwashed than on washed fresh produce. The washing practice at the household level may not avoid but can at least reduce the risk of foodborne illness that occurs with use of ready-to-eat vegetables
- The cross-contamination model used showed that inadequate washing of hands and cutting surfaces increases the risk of cross-contamination
- This study identified as a priority the need for consumer education regarding the proper washing of produce before consumption

- This study opens the path for developing and testing educational materials targeting the consumers' microenvironment through the formulation of recipes with instructions on CCPs
- Substantial differences between reported and observed food safety practices indicate the need for home-based observational studies to estimate the true food safety risks at the household level.

Reviewer Comments:

The reference for comparison of the present study's results with those consumer food safety surveys:

- *Dharod J, Pérez-Escamilla R, Paciello S, Venkitanarayanan K, Bermúdez-Millán A, Damio G. Comparison Between Self-reported and Observed Food Handling Behaviors Among Latinas. J Food Prot 2007; 70: 1,927-1,932.*

The basic demographic information was obtained from the authors' previously published article with the same study participants:

- *Dharod JM, Pérez-Escamilla R, Paciello S, Bermúdez-Millán A, Venkitanarayanan K, Damio G. Comparison between self-reported and observed food handling behaviors among Latinas. J Food Prot. 2007; 70: 1,927-1,932.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes

1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	???
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	N/A
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	N/A
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	N/A
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A

5. Was blinding used to prevent introduction of bias? `Yes`

5.1. In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate? `N/A`

5.2. Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.) `Yes`

5.3. In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded? `N/A`

5.4. In case control study, was case definition explicit and case ascertainment not influenced by exposure status? `N/A`

5.5. In diagnostic study, were test results blinded to patient history and other test results? `Yes`

6. Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described? `Yes`

6.1. In RCT or other intervention trial, were protocols described for all regimens studied? `N/A`

6.2. In observational study, were interventions, study settings, and clinicians/provider described? `N/A`

6.3. Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect? `N/A`

6.4. Was the amount of exposure and, if relevant, subject/patient compliance measured? `N/A`

6.5. Were co-interventions (e.g., ancillary treatments, other therapies) described? `N/A`

6.6. Were extra or unplanned treatments described? `N/A`

6.7. Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups? `N/A`

6.8. In diagnostic study, were details of test administration and replication sufficient? `Yes`

7. Were outcomes clearly defined and the measurements valid and reliable? `Yes`

7.1. Were primary and secondary endpoints described and relevant to the question? `Yes`

7.2. Were nutrition measures appropriate to question and outcomes of concern? `N/A`

7.3. Was the period of follow-up long enough for important outcome(s) to occur? `N/A`

7.4. Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures? `Yes`

7.5. Was the measurement of effect at an appropriate level of precision? `Yes`

7.6.	Were other factors accounted for (measured) that could affect outcomes?		Yes
7.7.	Were the measurements conducted consistently across groups?		N/A
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?		Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?		Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?		Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?		N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?		Yes
8.6.	Was clinical significance as well as statistical significance reported?		Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?		N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		???
9.1.	Is there a discussion of findings?		Yes
9.2.	Are biases and study limitations identified and discussed?		No
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
10.1.	Were sources of funding and investigators' affiliations described?		Yes
10.2.	Was the study free from apparent conflict of interest?		Yes